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(54) Electronic parts and method producing the same

Elektronische Bauteile und Verfahren zu ihrer Herstellung

Composants électroniques et leur procédé de fabrication

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to electronic parts formed in a multilayer structure by use of a resin or a compound material made by mixing powder functional material into this resin, and to a method of producing the same.

[0002] As a method of producing multilayer electronic parts by use of thin film conductors, JP-A-5-267063 discloses a method in Fig. 5 of the drawings attached herewith. As shown in the same, for instance, in case of producing an inductor, powders of raw material are mixed for providing desired functions as ferrite (Step S1), and granulating and pulverizing are carried out (Step S2). Then, the substances mixed and regulated in predetermined grain diameter are turned out to be enamels by use of binder and solvent (Step S3).

[0003] Laminating and baking steps carry out a screen printing (Step S4) of the ferrite paste, a pre-baking (Step S5) by rising temperature in a drying furnace, installation of inductor electrodes (Step S6) by forming the film through any of an evaporation, a spattering and an ion plating, and a screen printing (Step S7) of the ferritepaste. Thesesteps are repeated several times until obtaining patterns of desired number. The forming of the electrode patterns is carried out simultaneously for many pieces of inductors.

[0004] Thereafter, products are cut per each of chips (Step S8), and the chips are formed on sides with external electrodes by coating, evaporation or spattering (Step S9). Subsequently, other areas than the external electrodes are subjected to a silicone impregnation so that pores in the chip surface are impregnated with a synthetic (silicone) resin (Step S10). IF necessary, the external electrodes are subjected to an electroplating (Step S11).

[0005] For producing the multiplayer electronic parts using a resin or a compound material made by mixing functional materials (dielectric powder or magnetic powder) with this resin and thin film conductor formed by the evaporation or the like, the multilayer electronic parts are produced by repeating the printing of the compound material paste, the thermosetting and the forming of the thin film conductor.

[0006] In case of producing the electronic parts by the procedure of repeating the printing and the hardening as seen in the conventional examples, there have been problems that production cost is high, and a period till production is very long.

[0007] From US-A-5,652,561(closest prior art), there is known an electronic part comprising a conventional core substrate comprising a resin material or an instaling film. Coils formed on both the front and back surfaces of the core substrate are formed by print wiring techniques. More precisely, US-A-5,652,561 discloses an electronic part comprising a core substrate which is made by forming a resin into a thin plate, and hardening it; thin film conductor formed on at least one of front and back surfaces of the core substrate through a thin film forming technique such as evaporating and plating, and carried out with a patterning; and adhesive layer formed with a resin, and interposed between core substrates formed with the thin film conductor, wherein laminated layers made of the core substrates and prepregs provided between the core substrates as the adhesive layers are unified by hot-pressing.

[0008] From EP-A-918 340, a composite material is known in which ferrite powder is mixed with resin. According to the above prior art document, conductors are formed by printing and heating a conductive paste.

[0009] GB-A-781,470 discloses a wound type capacitor comprising laminated flexible sheets and aluminum foils. Titanate, in particular barium titanate, is mixed to said flexible sheet.

[0010] In addition, in the case of ceramics, for printing or forming the thin film conductor after baking, influences of fragility of a prime body are easy to appear, or as stress is loaded thereon, problems about cracks or warp easily occur. Laminated layers are baked for hours by nature, and when the number of layer increases, a long production time and cost are consumed.

[0011] Also in the case of the resin or the compound material, since the thermosetting and the printing are repeated to cause large stress loading thereon, the printed faces are roughened and when the number of layer increases, it becomes difficult to produce.

SUMMARY OF THE INVENITON

[0012] In view of the above mentioned problems, it is an object of the invention to provide electronic parts and a method of producing the same in which the producing time is shortened, and crack or warp are hard to occur, reduction of cost can be attained, and the production can be performed even if the number of layer is many.

[0013] A method of producing electronic parts of a first aspect of the invention is characterized by comprising: forming a compound material made by mixing powder-like functional materials selected from magnetic material powder and dielectric material powder with a resin into thin plates hardening them to be core substrates; forming thin film conductors having a thickness of more than 0.3 μm but less than 5 μm on at least one of front and back surfaces of the core substrates through any of an evaporation process, an ion plating process, an ion beam process, a vapor deposition process, and a sputtering process, followed by patterning; forming said compound material made by mixing said powder-like functional materials with a resin into prepreg like thin plates, alternately laminating half-hardened prepregs and the core substrates, and subsequently hot-pressing and unifying into multilayer parts.

[0014] As should be clear, if the core substrate and the prepreg are separately produced, and lamination

and hardening are carried out concurrently, the production time can be shortened and the cost is lowered. Since the whole is once hardened by hot-pressing, crack or warp are hard to occur, and the production is possible even though the number of layer is many.

[0015] Further, the thin film conductor can be made thin, so that it is possible to firstly make parts thin (in particular, this effect is remarkably in a capacitor), secondly heighten patterning precision and accuracy in layer-to-layer, and thirdly avoid migration because the thin film conductor is thin so that the resin is buried around its periphery. In this application, the term "powder-like" includes grain form, flake form, needle form, spike form, or the like.

[0016] An electronic part of a second aspect of the invention is characterized by comprising: a core substrate made by forming a compound material made by mixing a powder-like functional materials selected from magnetic material powder and dielectric material powder with a resin into thin plates, and hardening them; a thin film conductor formed on at least one of front and back surfaces of the core substrate through the film forming technique and carried out with a patterning; and an adhesive layer formed with said compound material made by mixing said powder-like functional material with a resin, and interposed among core substrates formed with the thin film conductors; wherein laminated layers made of the core substrates and prepregs provided between the core substrates as the adhesive layers are unified by hot-pressing, wherein said thin film conductor has a thickness of more than 0.3 μm but less than 5 μm.

[0017] If the electronic parts are composed of such a laminated structure, as mentioned in the first aspect, the production time can be shortened, the cost is lowered and crack or warp are avoided from occurrence.

[0018] When the thickness is more than 5 μm, time is taken too much for forming the thin film, and it is difficult to shorten the production time. Because the thickness restricted less than 5 μm, it is possible to avoid the manufacturing time from becoming long. In case of the thickness is less than 1 μm, a conductor resistance becomes large. Therefore, in order to maintain a Q value at a predetermined level, thickness of the thin film conductor preferably has more than 1μm. However, in case of capacitor or noise removing circuit which allows large loss, thickness of the thin thin film conductor may be less than 1μm, but more than 0.3μm.

[0019] Moreover, according to the electronic part of the present invention, as a resin, at least one thermosetting resin selected from a group consisting of epoxy resin, phenol resin, unsaturated polyester resin, vinyl ester resin, polyimide resin, bismaleimidotriazine (cyanate ester) resin, polyphenyle ether (oxide) resin, fumarate resin, polybutadiene resin, and vinylbenzyl resin, or at least one thermoplastic resin selected from a group consisting of aromatic polyester resin, polyphenylene sulfide resin, polyethylene terephtharate resin, polybutylene terephtalate resin, polyethylene sulfide resin, polyethyl ehter ketone resin, polytetrafluoroethylene resin, polyarylate resin and graft resin, or a composite resin composed of at least one of the thermosetting resin and at least one of the thermoplastic resin may be used.

[0020] Moreover, according to the electronic part of the present invention, as the powder-like functional material, at least one ferrite magnetic material selected from a group consisting of Mn-Mg-Zn based magnetic material, Ni-Zn based magnetic material, and Mn-Zn based magnetic material, or at least one ferromagnetic metallic magnetic material selected from a group consisting of carbonyl iron, iron-silicon based alloy, iron-aluminum-silicon based alloy, iron-nickel based alloy, and amorphous (iron based or cobalt based) alloy, or at least one dielectric material selected from a group consisting of $BaO-TiO_2-Nd_2O_3$ based dielectric material, $BaO-TiO_2-SnO_2$ based dielectric material, PbO-CaO based dielectric material, TiO_2 based dielectric material, $BaTiO_3$ based dielectric material, $PbTiO_3$ based dielectric material, $SrTiO_3$ based dielectric material, $CaTiO_3$ dielectric material, Al_2O_3 based dielectric material, $BiTiO_4$ based dielectric material, $MgTiO_3$ based dielectric material, $(Ba, Sr)TiO_3$ based dielectric material, $Ba(Ti, Zr)O_3$ based dielectric material, $BaTiO_3-SiO_2$ based dielectric material, $BaO-SiO_2$ based dielectric material, $CaWO_4$ based dielectric material, $Ba(Mg, Nb)O_3$ based dielectric material, $Ba(Mg, Ta)O_3$ based dielectric material, $Ba(Co, Mg, Nb)O_3$ based dielectric material, $Ba(Co, Mg, Ta)O_3$ based dielectric material, Mg_2SiO_4 based dielectric material, $ZnTiO_3$ based dielectric material, $SrZrO_3$ based dielectric material, $ZrTiO_4$ based dielectric material, $(Zr, Sn)TiO_4$ based dielectric material, $BaO-TiO_2-Sm_2O_3$ based dielectric material, $PbO-BaO-Nd_2O_3-TiO_2$ based dielectric material, $(Bi_2O_3, PbO)-BaO-TiO_2$ based dielectric material, $La_2Ti_2O_7$ based dielectric material, $Nd_2Ti_2O_7$ based dielectric material, $(Li, Sm)TiO_3$ based dielectric material, $Ba(Zn, Ta)O_3$ based dielectric material, $Ba(Zn, Nb)O_3$ based dielectric material and $Sr(Zn, Nb)O_3$ based dielectric material, or composite functional material composed of at least two of the above mentioned ferrite magnetic materials, ferromagnetic metallic magnetic materials, and dielectric materials may be used.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a processing diagram showing one embodiment of the production method of the electronic parts according to the invention;

Figs. 2A to 2E are explanatory views of procedures of one parts practicing the production method of the electronic part according to the invention;

Figs. 3A to 3E are explanatory views of procedures of remaining parts practicing the production method

of the electronic part according to the invention;
Fig. 4A is a cross sectional view showing one example of the electronic part according to the invention, and Fig. 4B is a view of layer-structure; and
Fig. 5 is a procedure showing the conventional production method of the electronic part.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Fig. 1 is a processing diagram showing one embodiment of the production method of the electronic parts according to the invention, and Figs. 2 and 3 are explaining views illustrating respective steps.

[0023] In the Step S1 of Fig. 1, for producing the compound material, to a resin is added a powder-like functional material selected from magnetic material powder or dielectric material powder, and
a solvent such as toluene, and kneaded to make a paste. Herein, as the resins, at least one thermosetting resin selected from a group consisting of epoxy resin, phenol resin, unsaturated polyester resin, vinyl ester resin, polyimide resin, bismaleimidotriazine (cyanate ester) resin, polyphenyle ether (oxide) resin, fumarate resin, polybutadiene resin, and vinilbenzyl resin, or at least one thermoplastic resin selected from a group consisting of aromatic polyester resin, polyphenylene sulfide resin, polyethylene terephtharate resin, polybutylene terephtalate resin, polyethylene sulfide resin, polyethyl ehter ketone resin, polytetrafluoroethylene resin, polyarylate resin and graft resin, or a composite resin composed of at least one of the thermosetting resin and at least one of the thermoplastic resin may be used.

[0024] The powder-like functional material to be mixed with these resin is at least one ferrite magnetic material selected from a group consisting of Mn-Mg-Zn based magnetic material, Ni-Zn based magnetic material, and Mn-Zn based magnetic material, or at least one ferromagnetic metallic magnetic material selected from a group consisting of carbonyl iron, iron-silicon based alloy, iron-aluminum-silicon based alloy, iron-nickel based alloy, and amorphous (iron based or cobalt based) alloy, or at least one dielectric material selected from a group consisting of BaO-TiO_2-Nd_2O_3 based dielectric material, BaO-TiO_2-SnO_2 based dielectric material, PbO-CaO based dielectric material, TiO_2 based dielectric material $BaTiO_3$ based dielectric material, $PbTiO_3$ based dielectric material, $SrTiO_3$ based dielectric material, $CaTiO_3$ based dielectric material, Al_2O_3 based dielectric material, $BiTiO_4$ based dielectric material, $MgTiO_3$ based dielectric material, $(Ba, Sr)TiO_3$ based dielectric material, $Ba(Ti, Zr)O_3$ based dielectric material, $BaTiO_3$-SiO_2 based dielectric material, BaO-SiO_2 based dielectric material, $CaWO_4$ based dielectric material, $Ba(Mg, Nb)O_3$ based dielectric material, $Ba(Mg, Ta)O_3$ based dielectric material, $Ba(Co, Mg, Nb)O_3$ based dielectric material, $Ba(Co, Mg, Ta)O_3$ based dielectric material, Mg_2SiO_4 based dielectric material, $ZnTiO_3$ based dielectric material, $SrZrO_3$ based dielectric material, $ZrTiO_4$ based dielectric material, $(Zr, Sn)TiO_4$ based dielectric material, BaO-TiO_2-Sm_2O_3 based dielectric material, PbO-BaO-Nd_2O_3-TiO_2 based dielectric material, (Bi_2O_3, PbO)-BaO-TiO_2 based dielectric material, $La_2Ti_2O_7$ based dielectric material, $Nd_2Ti_2O_7$ based dielectric material, $(Li, Sm)TiO_3$ based dielectric material, $Ba(Zn, Ta)O_3$ based dielectric material, $Ba(Zn, Nb)O_3$ based dielectric material and $Sr(Zn, Nb)O_3$ based dielectric material, or composite functional material composed of at least two of the above mentioned ferrite magnetic materials, ferromagnetic metallic magnetic materials, and dielectric materials may be used.

[0025] For reducing the invention to practice, other resin, magnetic powder and dielectric powder may be of course served.

[0026] In the Step S2 of Fig. 1, the prepreg is made as shown in Fig. 2A. That is, a glass cloth wound on a reel 3 is drawn out into a container 1 supporting the paste 2 of the compound material, and is immersed in the paste 2. Subsequently, the paste coated on the glass cloth 4 is dried by passing the glass cloth 4 through a dryer 5, and a blank material 7 is wound on a reel 6. Then, this blank material 7 is cut by a cutter 8 into desired sizes as shown in Fig. 2B, and glass-cloth-contained prepregs 9 are produced.

[0027] The thus produced prepregs are divided into left-side Steps S3 to S6 of Fig. 1 and a right-side Step S7, and utilized as the core substrate 9a (see Fig. 2C) or as the prepreg 9b as a half hardened adhesive layer (see Fig. 2F). For forming the core substrate (Step S3), in case, e.g., the vinyl benzyl resin is used to the compound material paste, it is carried out at 200°C for 2 hours.

[0028] As to the half-hardening of the prepreg 9b of Step S7, in case of using, for example, vinyl benzyl resin in the compound material 2, it is practiced at 110°C for 1 hour.

[0029] In the thin film conductor forming process in Step S4, as shown in Fig. 2D, the thin film conductor 10 is formed on the front and back surfaces of the core substrate 9a through the thin film forming technique such as the evaporation process, the ion plating process, the ion beam process, the sputtering process, and the vapor deposition process. In this case, as the thin film conductor 10, copper, silver, nickel, tin, zinc, or aluminum may be used.

[0030] In the patterning process of Step S5, a resist film is formed on the core substrate 9a, and passing through exposure for forming patterns of conductor layer thereafter, partial removal of the resist film, thin film conductor etching on the removed areas, and resist film removing process, the patterned thin film conductors 11 are formed in Fig. 2E. The thin film conductors 11 are many on one sheet of core substrate 9a, and a plurality of the same patterns are arranged longitudinally and laterally. There is also the method of forming a thin film

conductor pattern through a mask as methods other than the above patterning process.

[0031] In an inner via forming process of Step S6, as shown in Fig. 3A, via holes 12 are formed by drilling, punching or laser applying, and the inner wall thereof is plated with the conductor 13, and the patterns 11, 11 on the both surfaces of the core substrate 9a are connected each other. Thus, when plating conductor 13 in the inner wall of a via hole 12, proper masking, such as a resist film coating, is performed to thin film conductor 11 so as to not thicken the thickness of the conductor 11.

[0032] In a unification press of Step S8, as shown in Fig. 3B, the core substrate 9a and the prepreg 9b as the adhesive layer are alternately laminated, and subjected to hot-pressing at substantially hardening temperatures and for time therefor, whereby the layer of the prepreg 9b is also substantially hardened. Thus, the unified and laminated layers 14 are produced as shown in Fig. 3C.

[0033] In forming through-holes of Step S9, as shown in Fig. 3D, the through-holes 15 are formed by the drilling, punching or laser applying and the inner walls thereof are plated with the conductor 16, and the pattern 11-to-the pattern 11 on the both surfaces of the core substrate 9a or these inner patterns-to-the patterns 11, otherwise the inner pattern 11-to-the inner pattern 11 are connected each other.

[0034] In the plating process and cutting process in Step S10, the required plating as solder-plating is performed, followed by cutting into chips in pieces. As shown in Fig. 3E, when mounting parts 17, these parts 17 are soldered before or after cutting into pieces of chips.

[0035] The core substrate 9a and the prepreg 9b are separately made and laminated, and hardening are concurrently carried out, whereby the production time is shortened and the reduction of cost can be attained. In addition, as the whole is once hardened by the hot pressing, crack or warp are hard to occur. If the pattern 11 is formed by use of copper foil as conventionally, it is generally used a foil having thickness around 18 μm. On the other hand, when the pattern is formed with the thin film conductor 11 as the invention, a thin film of lower than 9 μm can be easily produced. Therefore, the laminated layers are less rugged by the thickness of the conductor 11, and properties when forming capacitors or inductors are little in dispersion.

[0036] The thickness of the thin film conductor 10 is preferably less than 5 μm. When the thickness of the thin film conductor 10 is more than 5 μm, time is taken too much for forming the thin film, and it is difficult to shorten the production time. Because the thickness restricted less than 5 μm, it is possible to avoid the manufacturing time from becoming long. In case of the thickness is less than 1 μm, a conductor resistance becomes large. Therefore, in order to maintain a Q value at a predetermined level, thickness of the thin film conductor preferably has more than 1μm. However, in case of capacitor or noise removing circuit which allows large loss, thickness of the thin film conductor may be less than 1μm, but more than 0.3μm.

[0037] Fig. 4A is a cross sectional view showing one example of the electronic part according to the invention, and Fig. 4B is a view of layer-structure. This example is a voltage controlled oscillator (VCO), and 9a is the core substrate, 9b is the prepreg or a prepreg hardened and adhered to the core substrate 9a. Reference numeral 19 is a surface land pattern, 20 is capacitor electrodes, 21 is ground electrodes holding strip lines 22 composing a resonator therebetween. Reference numeral 17 is parts of semi-conductor such as transistors or variable capacitance diode, or mounted parts comprising capacitor of large capacitance, inductor chip, or chip resistor.

[0038] The invention can be realized, other than the above mentioned examples, as a capacitor, inductor, LC filter, LCR filter or various kinds of modules in which semiconductor devices and passive parts (circuit) are combined, that is, hybrid integrated. For reducing the invention to practice, it is possible to realize such a structure of forming the thin film conductor 11 only one side of the front and back surfaces of the core substrate 9a at a part or whole of the electronic part.

[0039] According to the present invention, in comparison with the conventional art in that copper foil is used, the thin film conductor of the present invention realizes to make electronic parts thin. Specifically, when the conventional electronic part include eight layers of 18μm copper foil which is generally used as conductor pattern and seven resin layers as insulation layer each having 60μm thickness, the thickness of the electonic part is 564μm (60μm x 7 + 18μm x 8 = 564μm).

[0040] On the other hand, in the example of the invention, when the thin film conductor 11 has 3μm thickness, and the other conditions (thickness of the resin layer and numbers of resin layers and conductor layers) are the same, the thickness of the electronic part of the present invention is 444μm (60μm x 7 + 3μm x 8 = 444μm). Thus, according to the invention, the electronic part thinner 120μm than the conventional can be obtained.

[0041] Further, according to the conventional art, minimum conductor pattern width is about 50μm and minimum distance betweenpatterns is also about 50μm. On the other hand, according to the present invention, minimum conductor pattern width is about 10μm and minimum distance between patterns is also about 10μm. Thus, the conductor pattern can be fine and pattern accuracy also can be improved.

[0042] According to the invention, as the core substrate and the prepreg are separately formed, alternately laminated, and hardened at the same time to produce the electronic part, the production time is shortened and the cost-down can be attained. As the whole is once hardened by the hot pressing, crack or warp are hard to occur. By making the conductor thin, it is possible to make the patterns fine and parts thin, heighten patterning precision and accuracy in layer-to-layer, and avoid

migration.

[0043] According to the invention, the thin film conductor is made less than 5 μm in thickness, so that the conductor thickness is not large, it is possible to avoid the time from becoming long.

Claims

1. An electronic part, comprising:

   core substrates which are made by forming a compound material made by mixing powder-like functional material selected from magnetic material powder and dielectric material powder with a resin into thin plates, and hardening same;
   thin film conductors formed on at least one of front and back surfaces of the core substrates through a thin film forming technique and carried out with a patterning; and
   adhesive layers formed with said compound material made by mixing said powder-like functional material with a resin, and interposed between core substrates formed with the thin film conductors,

   wherein laminated layers made of the core substrates and prepregs provided between the core substrates as the adhesive layers are unified by hot-pressing, wherein said thin film conductors have a thickness of more than 0.3 μm but less than 5 μm.

2. The electronic part as claimed in claim 1, wherein said resin comprises at least one thermosetting resin selected from a group consisting of epoxy resin, phenol resin, unsaturated polyester resin, vinyl ester resin, polyimide resin, bismaleimidotriazine (cyanate ester) resin, polyphenyle ether (oxide) resin, fumarate resin, polybutadiene resin, and vinylbenzyl resin.

3. The electronic part as claimed in claim 1, wherein said resin comprises at least one thermoplastic resin selected from a group consisting of aromatic polyester resin, polyphenylene sulfide resin, polyethylene terephtharate resin, polybutylene terephtalate resin, polyethylene sulfide resin, polyethyl ehter ketone resin, polytetrafluoroethylene resin, polyarylate resin and graft resin.

4. The electronic part as claimed in claim 1, wherein said resin comprises composite resin composed of at least one of the thermosetting resin and at least one of the thermoplastic resin,
   said thermosetting resin is selected from a group consisting of epoxy resin, phenol resin, unsaturated polyester resin, vinyl ester resin, polyimide resin, bismaleimidotriazine (cyanate ester) resin, polyphenyle ether (oxide) resin, fumarate resin, polybutadiene resin, and vinylbenzyl resin, and
   said thermoplastic resin is selected from a group consisting of aromatic polyester resin, polyphenylene sulfide resin, polyethylene terephtharate resin, polybutylene terephtalate resin, polyethylene sulfide resin, polyethyl ehter ketone resin, polytetrafluoroethylene resin, polyarylate resin and graft resin.

5. The electronic part as claimed in claim 1, wherein said powder-like functional material comprises at least one ferrite magnetic material selected from a group consisting of Mn-Mg-Zn based magnetic material, Ni-Zn based magnetic material, and Mn-Zn based magnetic material.

6. The electronic part as claimed in claim 1, wherein said powder-like functional material comprises at least one ferromagnetic metallic magnetic material selected from a group consisting of carbonyl iron, iron-silicon based alloy, iron-aluminum-silicon based alloy, iron-nickel based alloy, and amorphous (iron based or cobalt based) alloy.

7. The electronic part as claimed in claim 1, wherein said powder-like functional material comprises at least one dielectric material selected from a group consisting of BaO-TiO_2-Nd_2O_3 based dielectric material, BaO-TiO_2-SnO_2 based dielectric material, PbO-CaO based dielectric material, TiO_2 based dielectric material, $BaTiO_3$ based dielectric material, $PbTiO_3$ based dielectric material, $SrTiO_3$ based dielectric material, $CaTiO_3$ based dielectric material, Al_2O_3 based dielectric material, $BiTiO_4$ based dielectric material, $MgTiO_3$ based dielectric material, $(Ba, Sr)TiO_3$ based dielectric material, $Ba(Ti, Zr)O_3$ based dielectric material, $BaTiO_3$-SiO_2 based dielectric material, BaO-SiO_2 based dielectric material, $CaWO_4$ based dielectric material, $Ba(Mg, Nb)O_3$ based dielectric material, $Ba(Mg, Ta)O_3$ based dielectric material, $Ba(Co, Mg, Nb)O_3$ based dielectric material, $Ba(Co, Mg, Ta)O_3$ based dielectric material, Mg_2SiO_4 based dielectric material, $ZnTiO_3$ based dielectric material, $SrZrO_3$ based dielectric material, $ZrTiO_4$ based dielectric material, $(Zr, Sn) TiO_4$ based dielectric material, BaO-TiO_2-Sm_2O_3 based dielectric material, PbO-BaO-Nd_2O_3-TiO_2 based dielectric material, (Bi_2O_3, PbO)-BaO-TiO_2 based dielectric material, $La_2Ti_2O_7$ based dielectric material, $Nd_2Ti_2O_7$ based dielectric material, $(Li, Sm) TiO_3$ based dielectric material, $Ba(Zn, Ta) O_3$ based dielectric material, $Ba(Zn, Nb)O_3$ based dielectric material and $Sr(Zn, Nb)O_3$ based dielectric material.

8. The electronic part as claimed in claim 1, wherein

said powder-like functional material comprises composite functional material composed of at least two of mentioned ferrite magnetic materials, ferromagnetic metallic magnetic materials, and dielectric materials,

said ferrite magnetic material is selected from a group consisting of Mn-Mg-Zn based magnetic material, Ni-Zn based magnetic material, and Mn-Zn based magnetic material,

ferromagnetic metallic magnetic material is selected from a group consisting of carbonyl iron, iron-silicon based alloy, iron-aluminum-silicon based alloy, iron-nickel based alloy, and amorphous (iron based or cobalt based) alloy, and

dielectric material selected from a group consisting of $BaO\text{-}TiO_2\text{-}Nd_2O_3$ based dielectric material, $BaO\text{-}TiO_2\text{-}SnO_2$ based dielectric material, PbO-CaO based dielectric material, TiO_2 based dielectric material, $BaTiO_3$ based dielectric material, $PbTiO_3$ based dielectric material, $SrTiO_3$ based dielectric material, $CaTiO_3$ based dielectric material, Al_2O_3 based dielectric material, $BiTiO_4$ based dielectric material, $MgTiO_3$ based dielectric material, $(Ba, Sr)TiO_3$ based dielectric material, $Ba (Ti, Zr)O_3$ based dielectric material, $BaTiO_3\text{-}SiO_2$ based dielectric material, $BaO\text{-}SiO_2$ based dielectric material, $CaWO_4$ based dielectric material, $Ba (Mg, Nb)O_3$ based dielectric material, $Ba (Mg, Ta)O_3$ based dielectric material, $Ba(Co, Mg, Nb)O_3$ based dielectric material, $Ba(Co, Mg, Ta)O_3$ based dielectric material, Mg_2SiO_4 based dielectric material, $ZnTiO_3$ based dielectric material, $SrZrO_3$ based dielectric material, $ZrTiO_4$ based dielectric material, $(Zr, Sn) TiO_4$ based dielectric material, $BaO\text{-}TiO_2\text{-}Sm_2O_3$ based dielectric material, $PbO\text{-}BaO\text{-}Nd_2O_3\text{-}TiO_2$ based dielectric material, $(Bi_2O_3, PbO)\text{-}BaO\text{-}TiO_2$ based dielectric material, $La_2Ti_2O_7$ based dielectric material, $Nd_2Ti_2O_7$ based dielectric material, $(Li, Sm)TiO_3$ based dielectric material, $Ba(Zn, Ta)O_3$ based dielectric material, $Ba (Zn, Nb) O_3$ based dielectric material and $Sr (Zn, Nb) O_3$ based dielectric material.

9. A method of producing electronic parts, comprising the steps of:

forming a compound material made by mixing powder-like functional materials selected from magnetic material powder and dielectric material powder with a resin into thin plates, and hardening it to be core substrates,
forming thin film conductors having a thickness of more than 0.3 µm but less than 5 µm on at least one of front and back surfaces of the core substrates through any of an evaporation process, an ion plating process, an ion beam process, a vapor deposition process, and a sputtering process, followed by patterning,
forming said compound material made by mixing said powder-like functional materials with the resin into prepreg like thin plates, alternately laminating half-hardened prepregs and the core substrates, and
subsequently hot-pressing and unifying into laminated parts.

Patentansprüche

1. Elektronisches Bauteil, umfassend

- Kemsubstrate, welche hergestellt sind durch Ausformen eines Verbundmaterials zu einer dünnen, erhärtbaren Platte, wobei das Verbundmaterial hergestellt ist durch Mischen von pulverförmigem funktionellen Material, ausgewählt aus magnetischem Pulvermaterial und dielektrischem Pulvermaterial, mit einem Harz,
- Dünnfilm-Konduktoren, die mittels einer Dünnfilmbildungstechnik auf der Vorder- und/oder der Rückseite der Kernsubstrate ausgebildet sind und eine Rasterung aufweisen,
- aus dem Verbundmaterial durch Mischen des pulverförmigen funktionellen Materials mit einem Harz hergestellte Kleberschichten, welche eingefügt sind zwischen mit den Dünnfilm-Konduktoren versehenen Kernsubstraten,

wobei laminierte Schichten, bestehend aus Kemsubstraten und als Kleberschicht zwischen den Kemsubstraten angeordneten Prepregs, durch Warmpressen miteinander verbunden sind und die Dünnfilm-Konduktoren eine Dicke von mehr als 0,3 µm, aber weniger als 0,5 µm, aufweisen.

2. Elektronisches Bauteil nach Anspruch 1, wobei das Harz wenigstens ein wärmehärtendes Harz umfasst, ausgewählt aus einer Epoxidharz, Phenolharz, ungesättigtes Polyesterharz, Vinylesterharz, Polyimidharz, Bismaleimidotriazin-(Cyanatester) -Harz, Polyphenylether-(Oxid)-Harz, Fumaratharz, Polybutadienharz und Vinylbenzylharz umfassenden Gruppe.

3. Elektronisches Bauteil nach Anspruch 1, wobei das Harz wenigstens ein thermoplastisches Harz aus der folgenden Gruppe aufweist: aromatisches Polyesterharz, Polyphenylensulfidharz, Polyethylenterephthalatharz, Polybutylentherephthhalatharz, Polyethylensulfidharz, Polyethyletherketonharz, Polytetrafluoroethylenharz, Polyarylatharz und Pfropfharz.

4. Elektronisches Bauteil nach Anspruch 1, wobei das

Harz Kompositharz, zusammengesetzt aus wenigstens einem wärmehärtenden Harz und wenigstens einem thermoplastischen Harz, enthält, wobei das wärmehärtende Harz ausgewählt ist aus einer aus Epoxidharz, Phenolharz, ungesättigtem Polyesterharz, Vinylesterharz, Polyimidharz, Bismaleimidotriazin-(Cyanatester)-Harz, Polyphenylether-(Oxid)-Harz, Fumaratharz, Polybutadienharz und Vinylbenzylharz bestehenden Gruppe, und das thermoplastische Harz ausgewählt ist aus einer aus Polyesterharz, Polyphenylensulfidharz, Polyethylenterephthalatharz, Polybutylenterephthalatharz, Polyethylensulfidharz, Polyethyletherketonharz, Polytetrafluoroethylenharz, Polyarylatharz und Pfropfharz bestehenden Gruppe.

5. Elektronisches Bauteil nach Anspruch 1, wobei das pulverförmige, funktionelle Material wenigstens ein ferritisches, magnetisches Material umfasst, ausgewählt aus einer Gruppe, welche besteht aus auf Mn-Mg-Zn-basierendem magnetischen Material auf Ni-Zn-basierendem magnetischen Material und auf Mn-Zn basierendem magnetischen Material.

6. Elektronisches Bauteil nach Anspruch 1, wobei das pulverförmige, funktionelle Material wenigstens ein ferromagnetisches, metallisches, magnetisches Material umfasst, ausgewählt aus einer aus Carbonyleisen, auf Eisen-Silicium-basierenden Legierungen, auf Eisen-Aluminium-Silicium-basiemden Legierungen, auf Eisen-Nickel-basierenden Legierungen und amorphen (auf Basis Eisen oder Kobalt) Legierungen bestehenden Gruppe.

7. Elektronisches Bauteil nach Anspruch 1, wobei das pulverförmige funktionelle Material wenigstens ein dielektrisches Material umfasst, ausgewählt aus einer auf $BaO-TiO_2-Nd_2O_3$-basierendem dielektrischen Material, auf $BaO-TiO_2-SnO_2$-basierendem dielektrischen Material, auf PbO-CaO-basierendem dielektrischen Material, auf TiO_2-basierendem dielektrischen Material, auf $BaTiO_3$-basierendem dielektrischen Material, auf $PbTiO_3$-basierendem dielektrischen Material, auf $SrTiO_3$basierendem dielektrischen Material, auf $CaTiO_3$-basierendem dielektrischen Material, auf Al_2O_3-basierendem dielektrischen Material, auf $BiTiO_4$-basierendem dielektrischen Material, auf $MgTiO_3$-basierendem dielektrischen Material, auf $(Ba, Sr)TiO_3$-basierendem dielektrischen Material, auf $Ba(Ti, Zr)O_3$-basierendem dielektrischen Material, auf $BaTiO_3-SiO_2$-basierendem dielektrischen Material, auf $BaO-SiO_2$-basierendem dielektrischen Material, auf $CaWO_4$-basierendem dielektrischen Material, auf $Ba(Mg, Nb)O_3$-basierendem dielektrischen Material, auf $Ba(Mg,Ta)O_3$-basierendem dielektrischen Material, auf $Ba(Co,Mg,Nb)O_3$basierendem dielektrischen Material, auf $Ba(Co, Mg, Ta)O_3$-basierendem dielektrischen Material, auf Mg_2SiO_4-basierendem dielektrischen Material, auf $ZnTiO_3$-basierendem dielektrischen Material, auf $SrZrO_3$-basierendem dielektrischen Material, auf $ZrTiO_4$-basierendem dielektrischen Material, $(Zr, Sn) TiO_4$basierendem dielektrischen Material, auf $BaO-TiO_2-Sm_2O_3$-basierendem dielektrischen Material, auf $PbO-BaO-Nd_2O_3-TiO_2$-basierendem dielektrischen Material, auf $(Bi_2O_3, PbO)-BaO-TiO_2$-basierendem dielektrischen Material, auf $La_2Ti_2O_7$basierendem dielektrischen Material, auf $Nd_2Ti_2O_7$-basierendem dielektrischen Material, auf $(Li, Sm)TiO_3$-basierendem dielektrischen Material, auf $Ba (Zn, Ta)O_3$basierendem dielektrischen Material, auf $Ba(Zn, Nb)O_3$-basierendem dielektrischen Material und auf $Sr(Zn, Nb)O_3$-basierendem dielektrischen Material bestehenden Gruppe.

8. Elektronisches Bauteil nach Anspruch 1, wobei das pulverförmige funktionelle Material funktionales Kompositmaterial umfasst, welches zusammengesetzt ist aus wenigstens zwei der folgenden Materialien: ferritische, magnetische Materialien; ferromagnetische, metallische, magnetische Materialien und dielektrischen Materialen, wobei das ferritische, magnetische Material ausgewählt ist aus einer Gruppe, bestehend aus auf Mn-Mg-Zn-basierendem magnetischen Material, auf Ni-Zn-basierendem magnetischen Material und auf Mn-Znbasierendem magnetischen Material; das ferromagnetische, metallische, magnetische Material ausgewählt ist aus einer Gruppe, bestehend aus Carbonyleisen, auf Eisen-Silicium-basierenden Legierungen, auf Eisen-Aluminium-Silicium-basierenden Legierungen, auf Eisen-Nickel-basierenden Legierungen und auf amorphen (auf Basis Eisen oder Kobalt basierenden) Legierungen, und wobei das dielektrische Material ausgewählt ist aus einer Gruppe bestehend aus auf $BaO-TiO_2-Nd_2O_3$-basierendem dielektrischen Material, $BaO-TiO_2-SnO_2$basierendem dielektrischen Material, PbO-CaO-basierendem dielektrischen Material, TiO_2-basierendem dielektrischen Material, $BaTiO_3$-basierendem dielektrischen Material, $PbTiO_3$-basierendem dielektrischen Material, $SrTiO_3$-basierendem dielektrischen Material, $CaTiO_3$-basierendem dielektrischen Material, Al_2O_3basierendem dielektrischen Material, $BiTiO_4$-basierendem dielektrischen Material, $MgTiO_3$- basierendem dielektrischen Material, $(Ba, Sr)TiO_3$-basierendem dielektrischen Material, $Ba(Ti, Zr)O_3$-basierendem dielektrischen Material, $BaTiO_3-SiO_2$basierendem dielektrischen Material, $BaO-SiO_2$-basierenden dielektrischen Material, $CaWO_4$-basierendem dielektrischen Material, $Ba(Mg, Nb)O_3$-basierendem dielektrischen Material, $Ba(Mg, Ta)O_3$-basierendem dielektrischen Material, $Ba(Co, Mg, Nb)O_3$-basierendem dielektrischen Material, Ba(Co, Mg, Ta)

O_3basierendem dielektrischen Material, Mg_2SiO_4-basierendem dielektrischen Material, $ZnTiO_3$-basierendem dielektrischen Material, $SrZrO_3$-basierendem dielektrischen Material, $ZrTiO_4$-basierendem dielektrischen Material, (Zr, Sn) TiO_4basierendem dielektrischen Material, BaO-TiO_2-Sm_2O_3-basierendem dielektrischen Material, PbO-BaO-Nd_2O_3-TiO_2-basierendem dielektrischen Material, (Bi_2O_3, PbO)-BaO-TiO_2-basierendem dielektrischen Material, $La_2Ti_2O_7$basierendem dielektrischen Material, $Nd_2Ti_2O_7$-basierendem dielektrischen Material, (Li, Sm)TiO_3-basierendem dielektrischen Material, Ba (Zn, Ta)O_3basierendem dielektrischen Material, Ba (Zn, Nb)O_3-basierendem dielektrischen Material und Sr (Zn, Nb)O_3-basierendem dielektrischen Material.

9. Verfahren zum Herstellen von elektronischen Bauteilen, umfassend die folgenden Schritte:

- Verarbeiten eines Verbundmaterials, hergestellt durch Mischen von pulverförmigen, funktionellen Materialien, ausgewählt aus magnetischem Materialpulver und dielektrischem Materialpulver, mit einem Harz zu dünnen Platten und Aushärten derselben zu Kemsubstraten,

- Ausbilden von Dünnfilmkonduktoren mit einer Dicke von mehr als 0,3 µm, aber weniger als 5 µm, auf den Vorder- und/oder den Rückseiten der Kemsubstrate mit Hilfe eines Verdampfungsverfahrens oder eines lonenplattierungsverfahrens oder eines lonenbeamverfahrens oder eines Niederschlagsverfahrens aus der Dampfphase oder eines Sputteringverfahrens, welchem sich ein Rastervorgang anschließt,

- Verarbeiten des durch Mischen des pulverförmigen, funktionellen Materials mit dem Harz hergestellten Verbundmaterials zu prepregartigen, dünnen Platten,

- alternierendes Laminieren von halberhärteten Prepregs mit Kernsubstraten und

- nachfolgendes Warmpressen und Vereinigen zu laminierten Bauteilen.

Revendications

1. Partie électronique comprenant :

des substrats d'âme qui sont réalisés en formant un matériau composite réalisé en mélangeant un matériau fonctionnel sous forme de poudre choisi parmi une poudre de matériau magnétique et une poudre de matériau diélectrique avec une résine selon des plaques minces et en réalisant leur durcissement ;
des conducteurs en film mince qui sont formés sur au moins l'une des surfaces avant et arrière des substrats d'âme par l'intermédiaire d'une technique de formation de film mince et qui sont mis en oeuvre à l'aide d'une conformation ; et
des couches adhésives qui sont formées à l'aide dudit matériau composite réalisé en mélangeant ledit matériau fonctionnel sous forme de poudre avec une résine et qui sont interposées entre des substrats d'âme qui sont formés avec les conducteurs à film mince,

dans laquelle des couches empilées constituées par les substrats d'âme et par des préimprégnés prévus entre les substrats d'âme en tant que couches adhésives sont unifiées au moyen d'une pression à chaud où lesdits conducteurs en film mince présentent une épaisseur supérieure à 0,3 µm mais inférieure à 5 µm.

2. Partie électronique selon la revendication 1, dans laquelle ladite résine comprend au moins une résine thermodurcissable qui est choisie parmi un groupe comprenant résine époxy, résine phénolique, résine polyester non saturée, résine ester vinylique, résine polyimide, résine bismaléimidotriazine (ester de cyanate), résine éther polyphénylène (oxyde), résine fumarate, résine polybutadiène et résine vinylbenzyle.

3. Partie électronique selon la revendication 1, dans laquelle ladite résine comprend au moins une résine thermoplastique choisie parmi un groupe comprenant résine polyester aromatique, résine sulfure de polyphénylène, résine téréphtharate de polyéthylène, résine téréphthalate de polybutylène, résine sulfure de polyéthylène, résine polyéthyle éther cétone, résine polytétrafluoréthylène, résine polyarylate et résine greffée.

4. Partie électronique selon la revendication 1, dans laquelle ladite résine comprend une résine composite qui est constituée par au moins une résine prise parmi la résine thermodurcissable et par au moins une résine prise parmi la résine thermoplastique,

ladite résine thermodurcissable est choisie parmi un groupe comprenant résine époxy, résine phénolique, résine polyester non saturée, résine ester vinylique, résine polyimide, résine bismaléimidotriazine (ester de cyanate), résine éther polyphénylène (oxyde), résine fumarate, résine polybutadiène et résine vinylbenzyle, et

ladite résine thermoplastique est choisie parmi un groupe comprenant résine polyester aromatique, résine sulfure de polyphénylène, résine téréphtharate de polyéthylène, résine téréphthalate

de polybutylène, résine sulfure de polyéthylène, résine polyéthyle éther cétone, résine polytétrafluoréthylène, résine polyarylate et résine greffée.

5. Partie électronique selon la revendication 1, dans laquelle ledit matériau fonctionnel sous forme de poudre comprend au moins un matériau magnétique de ferrite choisi parmi un groupe comprenant un matériau magnétique à base de Mn-Mg-Zn, un matériau magnétique à base de Ni-Zn et un matériau magnétique à base de Mn-Zn.

6. Partie électronique selon la revendication 1, dans laquelle ledit matériau fonctionnel sous forme de poudre comprend au moins un matériau magnétique métallique ferro-magnétique choisi parmi un groupe comprenant du fer carbonyle, un alliage à base de fer-silicium, un alliage à base de fer-aluminium-silicium, un alliage à base de fer-nickel et un alliage amorphe (à base de fer ou à base de cobalt).

7. Partie électronique selon la revendication 1, dans laquelle ledit matériau fonctionnel sous forme de poudre comprend au moins un matériau diélectrique choisi parmi un groupe comprenant un matériau diélectrique à base de $BaO-TiO_2-Nd_2O_3$, un matériau diélectrique à base de $BaO-TiO_2-SnO_2$, un matériau diélectrique à base de PbO-CaO, un matériau diélectrique à base de TiO_2, un matériau diélectrique à base de $BaTiO_3$, un matériau diélectrique à base de $PbTiO_3$, un matériau diélectrique à base de $SrTiO_3$, un matériau diélectrique à base de $CaTiO_3$, un matériau diélectrique à base de Al_2O_3, un matériau diélectrique à base de $BiTiO_4$, un matériau diélectrique à base de $MgTiO_3$, un matériau diélectrique à base de $(Ba, Sr)TiO_3$, un matériau diélectrique à base de $Ba(Ti, Zr)O_3$, un matériau diélectrique à base de $BaTiO_3-SiO_2$, un matériau diélectrique à base de $BaO-SiO_2$, un matériau diélectrique à base de $CaWO_4$, un matériau diélectrique à base de $Ba(Mg, Nb)O_3$, un matériau diélectrique à base de $Ba(Mg, Ta)O_3$, un matériau diélectrique à base de $Ba(Co, Mg, Nb)O_3$, un matériau diélectrique à base de $Ba(Co, Mg, Ta)O_3$, un matériau diélectrique à base de Mg_2SiO_4, un matériau diélectrique à base de $ZnTiO_3$, un matériau diélectrique à base de $SrZrO_3$, un matériau diélectrique à base de $ZrTiO_4$, un matériau diélectrique à base de $(Zr, Sn)TiO_4$, un matériau diélectrique à base de $BaO-TiO_2-Sm_2O_3$, un matériau diélectrique à base de $PbO-BaO-Nd_2O_3-TiO_2$, un matériau diélectrique à base de $(Bi_2O_3, PbO)-BaO-TiO_2$, un matériau diélectrique à base de $La_2Ti_2O_7$, un matériau diélectrique à base de $Nd_2Ti_2O_7$, un matériau diélectrique à base de $(Li, Sm)TiO_3$, un matériau diélectrique à base de $Ba(Zn, Ta)O_3$, un matériau diélectrique à base de $Ba(Zn, Nb)O_3$, un matériau diélectrique à base de $Sr(Zn, Nb)O_3$.

8. Partie électronique selon la revendication 1, dans laquelle ledit matériau fonctionnel sous forme de poudre comprend un matériau fonctionnel composite qui est constitué par au moins deux des matériaux magnétiques de ferrite mentionnés, des matériaux magnétiques métalliques ferro-magnétiques mentionnés et des matériaux diélectriques mentionnés,

ledit matériau magnétique de ferrite est choisi parmi un groupe comprenant un matériau magnétique à base de Mn-Mg-Zn, un matériau magnétique à base de Ni-Zn et un matériau magnétique à base de Mn-Zn ;

ledit matériau magnétique métallique ferromagnétique est choisi parmi un groupe comprenant fer de carbonyle, alliage à base de fer-silicium, alliage à base de fer-aluminium-silicium, alliage à base de fer-nickel et alliage amorphe (à base de fer ou à base de cobalt) ; et

ledit matériau diélectrique est choisi parmi un groupe comprenant un matériau diélectrique à base de $BaO-TiO_2-Nd_2O_3$, un matériau diélectrique à base de $BaO-TiO_2-SnO_2$, un matériau diélectrique à base de PbO-CaO, un matériau diélectrique à base de TiO_2, un matériau diélectrique à base de $BaTiO_3$, un matériau diélectrique à base de $PbTiO_3$, un matériau diélectrique à base de $SrTiO_3$, un matériau diélectrique à base de $CaTiO_3$, un matériau diélectrique à base de Al_2O_3, un matériau diélectrique à base de $BiTiO_4$, un matériau diélectrique à base de $MgTiO_3$, un matériau diélectrique à base de $(Ba, Sr) TiO_3$, un matériau diélectrique à base de $Ba(Ti, Zr) O_3$, un matériau diélectrique à base de $BaTiO_3-SiO_2$, un matériau diélectrique à base de $BaO-SiO_2$, un matériau diélectrique à base de $CaWO_4$, un matériau diélectrique à base de $Ba(Mg, Nb)O_3$, un matériau diélectrique à base de $Ba(Mg, Ta)O_3$, un matériau diélectrique à base de $Ba(Co, Mg, Nb)O_3$, un matériau diélectrique à base de $Ba(Co, Mg, Ta)O_3$, un matériau diélectrique à base de Mg_2SiO_4, un matériau diélectrique à base de $ZnTiO_3$, un matériau diélectrique à base de $SrZrO_3$, un matériau diélectrique à base de $ZrTiO_4$, un matériau diélectrique à base de $(Zr, Sn)TiO_4$, un matériau diélectrique à base de $BaO-TiO_2-Sm_2O_3$, un matériau diélectrique à base de $PbO-BaO-Nd_2O_3-TiO_2$, un matériau diélectrique à base de $(Bi_2O_3, PbO)-BaO-TiO_2$, un matériau diélectrique à base de $La_2Ti_2O_7$, un matériau diélectrique à base de $Nd_2Ti_2O_7$, un matériau diélectrique à base de $(Li, Sm)TiO_3$, un matériau diélectrique à base de $Ba(Zn, Ta)O_3$, un matériau diélectrique à base de $Ba(Zn, Nb)O_3$, un matériau diélectrique à base de $Sr(Zn, Nb)O_3$.

9. Procédé de fabrication de parties électroniques, comprenant les étapes de :

formation d'un matériau composite qui est réa-

lisé en mélangeant des matériaux fonctionnels sous forme de poudre choisis parmi une poudre de matériau magnétique et une poudre de matériau diélectrique avec une résine selon des plaques minces et en réalisant son durcissement de manière à constituer des substrats d'âme ;
formation de conducteurs en film mince présentant une épaisseur supérieure à 0,3 µm mais inférieure à 5 µm sur au moins l'une de surfaces avant et arrière des substrats d'âme par l'intermédiaire d'un quelconque processus pris parmi un processus d'évaporation, un processus de placage ionique, un processus par faisceau ionique, un processus de dépôt en phase vapeur et un processus de pulvérisation, suivie par une conformation ;
formation dudit matériau composite réalisé en mélangeant lesdits matériaux fonctionnels sous forme de poudre avec la résine selon des plaques minces sous forme de préimprégnés en empilant en alternance des préimprégnés à moitié durcis et les substrats d'âme ; et
ensuite, pression à chaud et unification selon des parties empilées.

FIG. 1

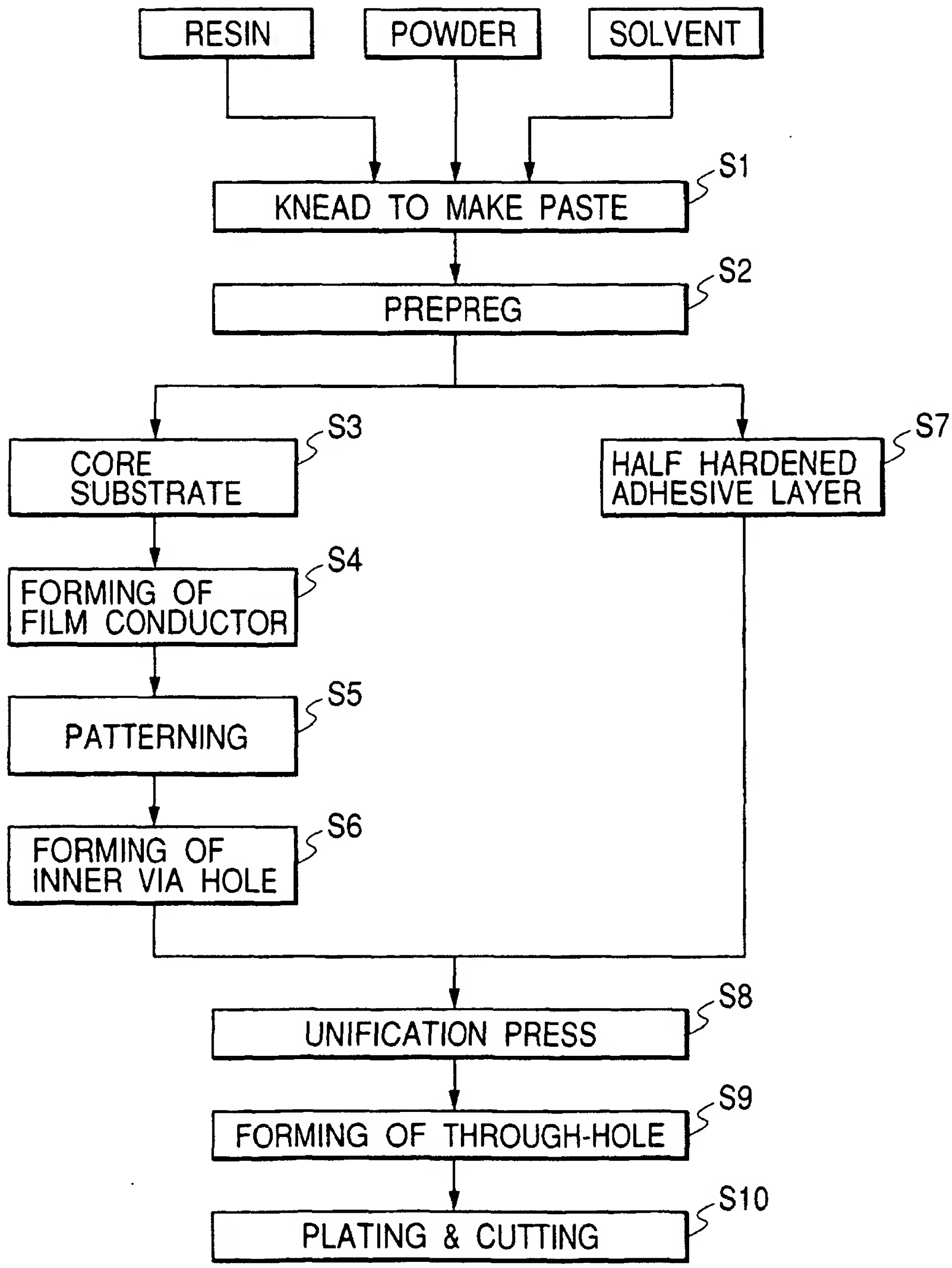

RESIN
POWDER
SOLVENT
KNEAD TO MAKE PASTE
S1
PREPREG
S2
CORE SUBSTRATE
S3
FORMING OF FILM CONDUCTOR
S4
PATTERNING
S5
FORMING OF INNER VIA HOLE
S6
HALF HARDENED ADHESIVE LAYER
S7
UNIFICATION PRESS
S8
FORMING OF THROUGH-HOLE
S9
PLATING & CUTTING
S10

FIG. 2A

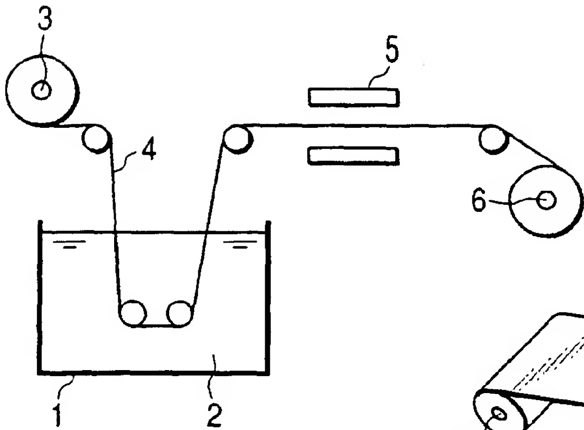


FIG. 2B

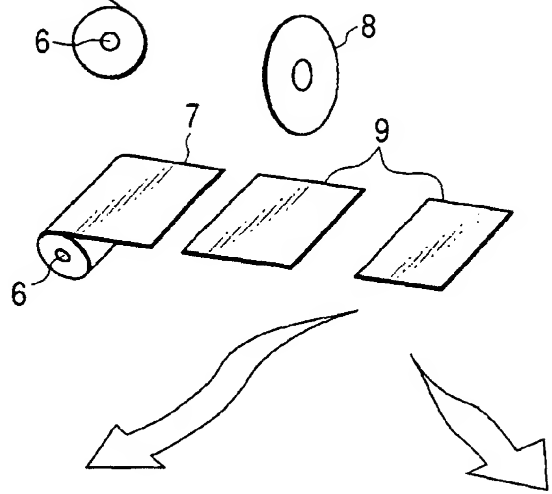


FIG. 2C

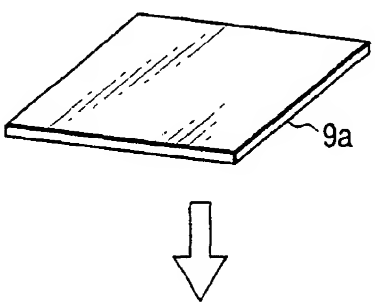


FIG. 2F

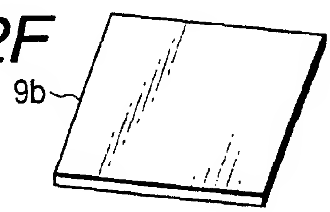


FIG. 2D

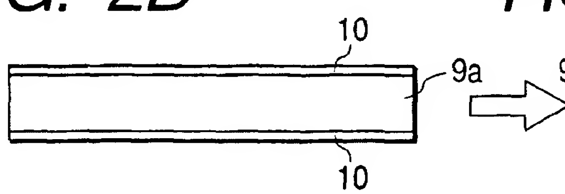


FIG. 2E

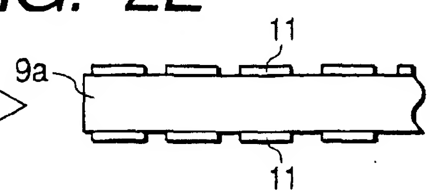


FIG. 3B

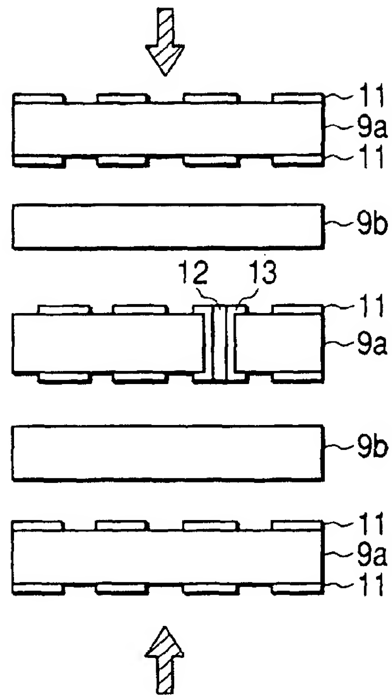


FIG. 3A

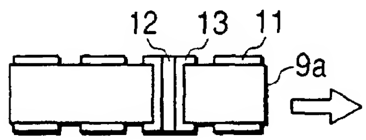


FIG. 3C

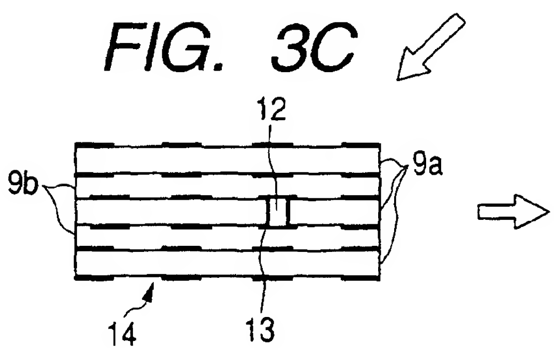


FIG. 3D

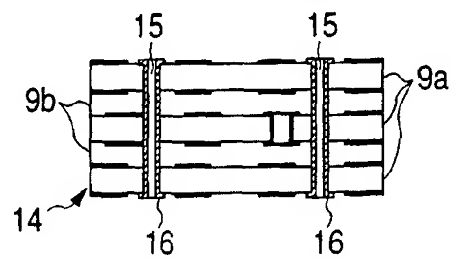


FIG. 3E

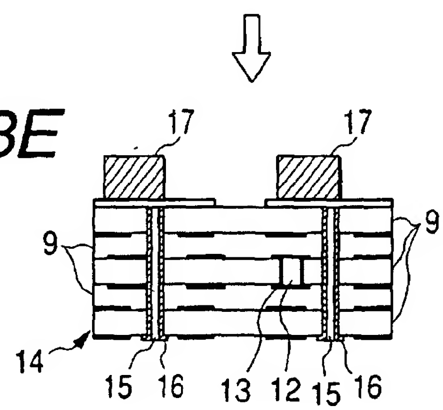
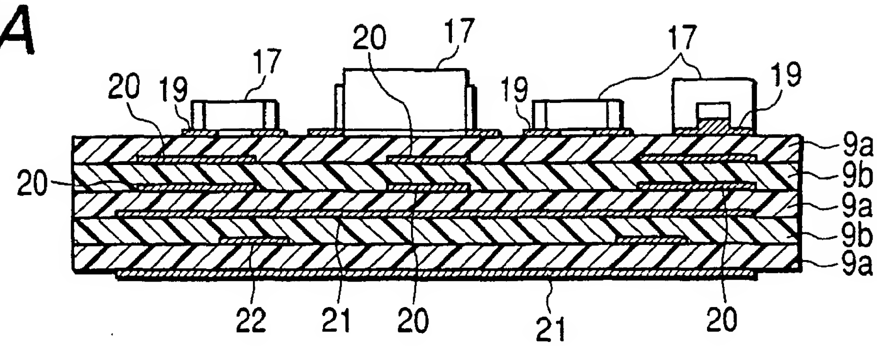


FIG. 4A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17
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17
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9a
9b
9a
9b
9a
20
22
21
20
21
20

FIG. 4B

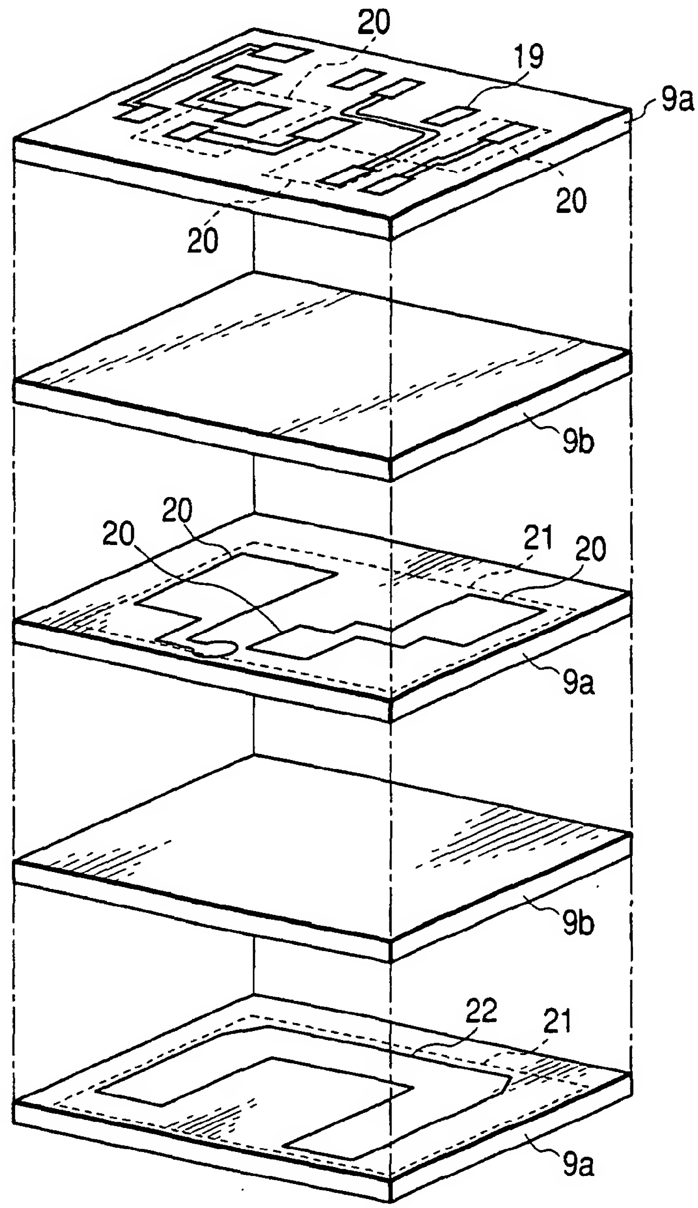
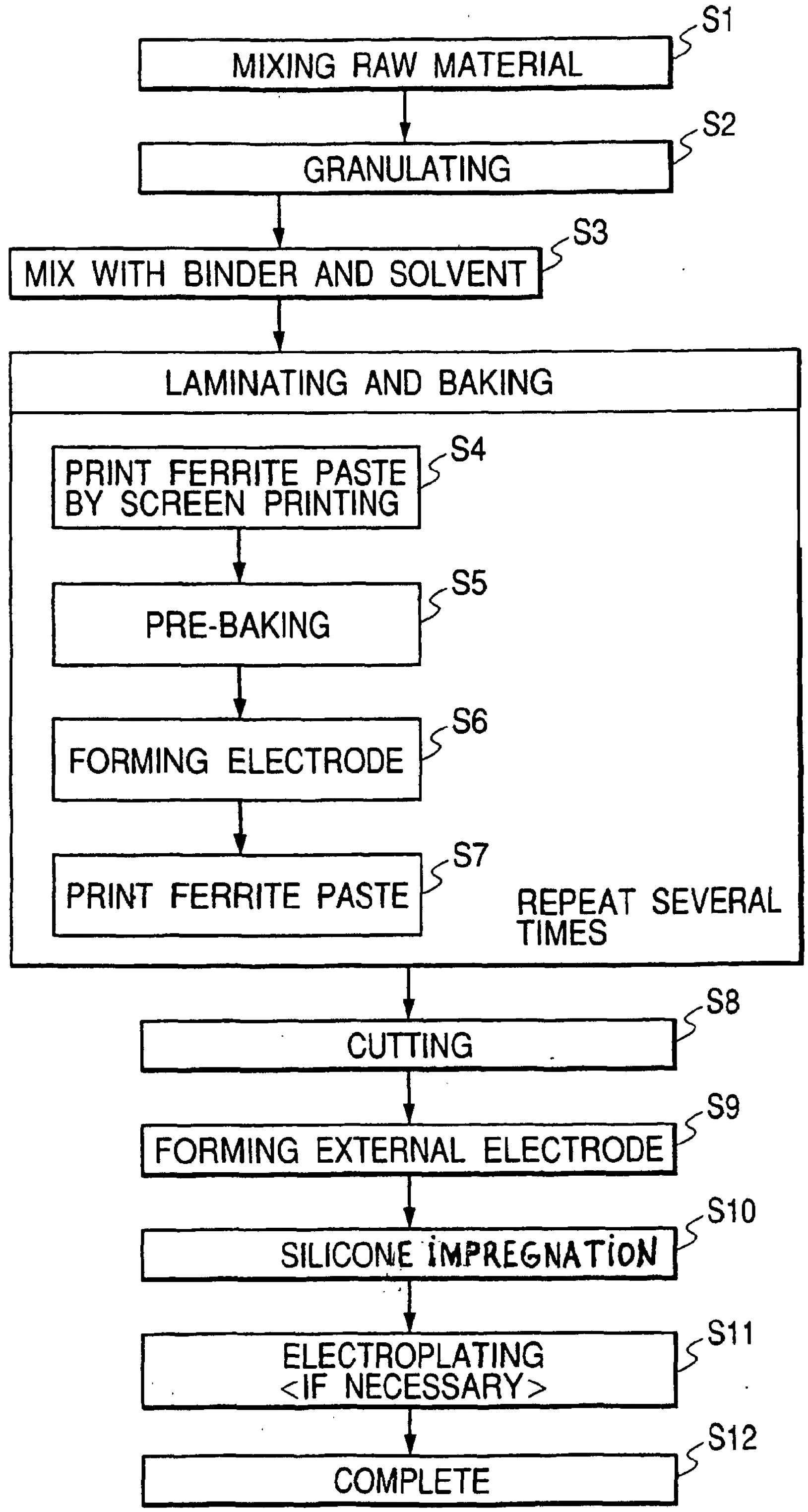

20
19
9a
20
20
9b
20
20
21
20
9a
9b
22
21
9a

FIG. 5


S1
MIXING RAW MATERIAL
S2
GRANULATING
S3
MIX WITH BINDER AND SOLVENT
LAMINATING AND BAKING
S4
PRINT FERRITE PASTE BY SCREEN PRINTING
S5
PRE-BAKING
S6
FORMING ELECTRODE
S7
PRINT FERRITE PASTE
REPEAT SEVERAL TIMES
S8
CUTTING
S9
FORMING EXTERNAL ELECTRODE
S10
SILICONE IMPREGNATION
S11
ELECTROPLATING
<IF NECESSARY>
S12
COMPLETE